

THE ENDEMIC HAWAIIAN CERAMBYCID BEETLES

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The main group of endemic Hawaiian cerambycid beetles, the Plagithmysines (subfamily Cerambycinae), represents one of the groups of insects which have proliferated spectacularly, having evolved in isolation over a long period of time from a single immigrant ancestor. Several other groups of insects have produced more species (i.e., Drosophilidae, Cixiidae, etc.) but most of those, and most Hawaiian insects, are smaller in size and many of them are less handsome. There are 136 known species of Plagithmysines. In addition, there are two isolated species--one a Megopis (subfamily Prioninae), the other a Parandra (subfamily Parandrinae)--which have not speciated, although both are represented on all of the main Hawaiian Islands; and there are 17 introduced species which, in general, attack only introduced trees. The ancestor of the Plagithmysines probably came from southwest N. America, in contrast to the ancestors of most Hawaiian insects which are Asian-Pacific. Air currents were the probable means of dispersal, although Megopis and Parandra probably reached Hawai'i in floating logs.

All cerambycids are borers in woody or semi-woody plants. The Plagithmysines, with very few exceptions, are associated only with native plants. They are notably host-specific and most are associated with only one genus or one species of host tree or shrub. Most of the beetles are (plant) genus-specific and some are clearly species-specific, as for instance the different beetle species that attack koa (Acacia koa Gray) and A. koaia Hbd. Each species seems to be restricted to a single island although species from East Maui, West Maui, Moloka'i, and Lāna'i are often very closely related. However, while some species are quite distinct, others should be called weak subspecies.

Only one-third of the native--endemic or indigenous--genera of Hawaiian woody plants are attacked by Plagithmysines. Certain very common plants such as kanawao (Broussaisia); ōlapa (Cheirodendron); pilo (Coprosma); wiliwili (Erythrina); and pūkiawe (Styphelia), etc., are not utilized. The most common host plants, in order of importance for the beetles, are koa (Acacia), alani (Pelea), 'ōhi'a (Metrosideros), māmane (Sophora), mamaki (Pipturus), hoi-kuahiwi (Smilax), hō'awa (Pittosporum), kāwa'u (Ilex), 'a'ali'i (Dodonaea), 'āweoweo (Chenopodium), 'akoko (Euphorbia), and kupaoa and na'ena'e (Dubautia). Those host plants known to be associated with two to three beetle species

include kauila (Alphitonia), 'ahakea (Bobea), hōlio (Cryptocarya), lama (Diospyros), kalia (Elaeocarpus), hinahina (Gerranium), uhiuhi (Mezoneuron), kōlea (Myrsine), uulei (Osteomeles), olomea (Perrottetia), 'ala'a (Planchonella), aulu and mānele (Sapindus), 'ōhi'a-hā (Syzygium), and ōpuhe (Urera). Those host plants known to be associated with one beetle species include hame (Antidesma), 'āhinahina (Argyroxiphium), kokoolau (Bidens), pāpala (Charpentiera), hāhā (?Cyanea), a'e (Fagara), nalo (Myoporum), olopua (Osmanthus), pilōkea (Platydesma), 'iliahi (Santalum), and koli'i (?Trematolobelia). Thus, there are approximately 39 host genera in 27 families with known insect associations. The 10 most important host families (i.e., those plant families with which the most species of beetles are associated), in order of importance, are the Pea family (Leguminosae); Rue or citrus family (Rutaceae); Myrtle family (Myrtaceae); Nettle family (Urticaceae); Sunflower family (Compositae); Soapberry family (Sapindaceae); Lily family (Liliaceae); Spurge family (Euphorbiaceae); Goosefoot family (Chenopodiaceae); and Holly family (Aquifoliaceae).

The Plagithmysines are primary wood-borers of living or unhealthy trees and shrubs. The eggs are laid through the bark with the female's ovipositor and the larvae bore under the bark into heartwood, or in roots to terminal stems. The pupal stage is passed in a cell made by the larva, usually in heartwood. Adults can fly, and are active and diurnal. The adults are not attracted to flowers or to light; however, they are attracted to the damaged or freshly fallen trees of their particular host species. It is not certain whether Plagithmysines frequently cause the death of a tree, but it is certain that they thin clumps of stems, as in hinahina, alani, and 'ōhelo (Vaccinium); and prune branches, as in koa, kawau, 'ōhi'a, etc. They also start the breakdown cycle of newly fallen trees or major branches, such as resulting from storm damage. They nearly always precede feeding by termites, moth borers, and other scavengers in standing or damaged trees.

The 136 species of Plagithmysines have been assigned to seven generic names in the past. With the recent discovery of some "missing links," the number has been reduced to five subgenera of the single genus Plagithmysus. Although their forms vary greatly--as much superficially as among quite different subfamilies of Cerambycidae--now they are all in a single genus because of the annectent forms found to be still living. Two of the recently added species responsible, in part, for the lumping were found in Haleakalā crater without knowledge of their hosts. One was assumed to be related to Artemisia (Maui wormwood, kuahiwi) because its nearest relatives are in Dubautia and Argyroxiphium, but I recently examined Artemisia in the Ko'olau Gap with negative results. The host might be Argyroxiphium virescens Hbd. (greensword). The other missing link was named for Cheirodendron from its label, but that probably is not the host, which might be 'ōhi'a or alani.

Host plants are known for nearly 90% of the 136 Plagithmysine species, as well as for at least two species of which only the larval forms have been collected. Clearly, there are more species to be discovered, if they can be found before their environments are eliminated. Because of the close association of certain species-groups with certain host genera, if one of a series has not been recorded from a particular island the species may be searched for and perhaps found. Such searching was done in recent years on West Maui, Moloka'i, and Lāna'i, and a number of the gaps have been filled. C. J. Davis has contributed to this knowledge, especially by learning host plants and habits. As the adults of these beetles are rarely seen, even with diligent searching, it is important for other biologists and ecologists to take note if any cerambycids are observed. For instance, it is assumed that these beetles may be significant prey of native birds, but there are almost no documentations of such feeding habits.

Eggs of the beetles may be predated upon by pseudoscorpions which are often abundant in the lower bark niche. It is known that parasitism (mostly by braconid wasps) is very high. Some of these parasitic wasps have shifted to cerambycids introduced to control weed plants such as lantana (Lantana camara L.). The effect of exotic predators has not been studied much for the native species but, in general, the Plagithmysines are no longer found at low altitudes where ants and other exotic predators are abundant. Little is known about flight habits, range, adult feeding habits, and longevity (several weeks in cages). Mating and egg-laying of the common koa species (P. varians) in Hawaii Volcanoes National Park (HAVO) have been documented. Also a fair amount is known about the 'ōhi'a species (P. bilineatus--see Nagata and Stein, this publication).

The island of Hawai'i has the greatest number of known species of Plagithmysines (46), followed by East Maui (28); O'ahu (20); Kaua'i (19); West Maui (10); Moloka'i (9); Lāna'i (3); and Nihoa (1). Most of the colonization of islands appears to have been from west to east, with apparently more primitive species on Nihoa and Kaua'i. Some of the more specialized elements are in O'ahu and the Maui group of islands. Two subgenera are limited to the Maui group; another subgenus occurs on both Maui and O'ahu. East Maui is represented by all five subgenera, and Kaua'i and Hawai'i each are represented by only the two largest subgenera.

There is a great deal more to be learned about the fascinating Plagithmysines - part of the fragile ecosystems of Hawai'i which so critically need protection.

LITERATURE CITED

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